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DEVICE FOR IMPACT SENSING

Background Information

The present invention is directed to a device for impact sensing according to the definition of the species in the independent claim.

From German patent application DE 102 10 131.0 (not a prior publication) it is known to communicate pressure data from a pressure sensor to a control unit as differential values or absolute values.

Advantages of the Invention

The device according to the present invention for impact sensing having the features of the independent claim has the advantage over the related art that normalized pressure values are now communicated. This ensures that the pressure signal is independent of the ambient pressure, and makes simple and inexpensive performance of the signal analysis in the central control unit possible. Furthermore, by shifting of the signal processing, better performance in the control unit may be expected. Finally, normalization of the pressure data provides the prerequisite for enabling the normalized pressure data to be compatible with the signals from acceleration sensors.

Through the measures and refinements set forth in the subclaims, advantageous improvements on the device for impact sensing in a vehicle specified in the independent claim are possible.

It is particularly advantageous that the signal is normalized to the ambient pressure. This ambient pressure may be detected by an additional sensor or it may already be stored in a memory, or the sensor element, i.e., in particular a micromechanical sensor element, is designed so that it already

outputs a normalized ambient pressure as the measured value. If an additional sensor is provided besides the pressure sensor for impact sensing, then this additional sensor should advantageously be used to register the ambient pressure outside of the largely enclosed element in which the pressure sensor for impact sensing is located. The pressure sensor for impact sensing works according to the principle of registering an adiabatic pressure increase that occurs because of a deformation of a vehicle part.

Drawing

An exemplary embodiment of the present invention is illustrated in the drawing and explained in greater detail in the following description.

Figure 1 shows a block diagram of the device according to the present invention, and

Figure 2 shows a flow chart of the sequence of operations on the processor of the device according to the present invention.

Description of the Exemplary Embodiment

Pressure sensors are known from industry and from automotive applications. Depending on the design, these transmit absolute or differential pressure values. In the case of the automobile, along with engine control, the pressure sensors are also being used more and more for sensing side impacts.

According to the present invention, provision is now made for the pressure signal to be normalized so as to simplify further processing. This results in the advantages that the pressure signal for the airbag triggering algorithm is independent of the ambient pressure and that the signal processing in the central control unit may be kept simple and inexpensive. If

this preprocessing is shifted to the relocated pressure sensors due to the normalization, better performance in the central control unit may be expected. In particular, normalization also makes compatibility of the signals from the pressure and acceleration sensors possible.

Pressure sensors are finding increasing use in modern restraint systems for measuring the deformation of the side doors in the event of a side impact. This is accomplished via an adiabatic pressure increase, which makes especially quick sensing of a side impact possible. Triggering times of a few milliseconds are possible here. For the pressure sensor, the useful signal in the case of an impact is in a first approximation proportional to the ambient pressure, i.e., as a function of the altitude at which the vehicle is being operated, as well as of the current weather situation. In order for these influence variables not to be taken into account in the triggering algorithm, the pressure signals are reprocessed appropriately. This may be carried out either in the sensor itself or in the control unit. In certain cases, by designing the sensor element appropriately it is even possible to map the signal processing, which in some circumstances may be an extremely cost-effective approach. The goal is to transmit a value such as:

$$P_{N1} = S \cdot \frac{(P - P_0)}{P_0}$$

or

$$P_{N2} = S \cdot \frac{P}{P_0}$$

where S is the scaling factor, P is the currently measured absolute pressure in the interior of the door and P_0 is the absolute ambient pressure. The advantage for the algorithm or the control unit, in addition to the non-dependency of the crash signal on the ambient pressure, is primarily that the

measure illustrated makes it possible for the pressure to be compatible with acceleration sensors that were formerly used exclusively.

Figure 1 shows a block diagram of the device according to the present invention. A sensing element or sensor element 1, for example a micromechanical diaphragm, acts here as a pressure-measuring element. The signal which is emitted by sensor element 1 is amplified by an amplifier 2, and is then passed to an analog-digital converter 3 to be digitized. The digitized signal is then passed to a signal preprocessor 4, which then passes the preprocessed signal to a transmitter module 5. Transmitter module 5 transmits the filtered signal via a line 6 to a control unit, namely to a receiving module 7. Receiving module 7 then passes the received signal to a processor 8, which employs a memory 9 to use the pressure signal via a data input/output for a triggering algorithm for restraining devices. As a function of the analysis of this triggering algorithm, a restraining means 10, for example an airbag or belt tensioner, is then activated. Hence the pressure sensor is made up of sensor element 1, amplifier 2, analog-digital converter 3, signal preprocessor 4 and transmitter module 5. These elements are housed in an enclosure and located in the side part of a vehicle, in order to measure an adiabatic pressure increase in the event of a side impact. The pressure sensor acts then as an indirect deformation sensor. Only one pressure sensor is shown here as an example, but it is usually the case that at least two pressure sensors are located on opposite sides of the vehicle, or for example even four, in order to monitor all doors of a four-door vehicle, for example. The pressure sensor in this case must be located in particular in a largely enclosed part of the vehicle, so that there may be an adiabatic pressure increase.

Alternatively, it is also possible for such a pressure sensor to be placed in other parts of the vehicle, in order to detect a front impact, an offset impact, or a rear impact, for example. It is important here for an adiabatic pressure increase to be possible in order to enable quick sensing through the pressure increase. Receiving module 7, processor 8, and memory 9 are located in the control unit, which may be situated for example on the vehicle tunnel, but they may also be located in the pressure sensor itself. Adjacent to it there may also be other components, including in particular a connection to an acceleration sensor as a plausibility sensor. The acceleration sensor itself may also be positioned in immediate proximity to processor 8. Instead of an acceleration sensor, other sensor types such as structure-borne sound detectors or deformation sensors may also act as plausibility sensors. Only if this plausibility sensor also signals an impact is processor 8 able to activate restraining means 10. If the control unit is positioned centrally in the vehicle, then line 6 takes the form a two-wire line here. A unidirectional connection from the pressure sensor to the control unit is provided here in particular. In this case a direct current is put on line 6 by the control unit, in order to supply the pressure sensor with the necessary power. To transmit data, the pressure sensor impresses the measuring signal in the form of current fluctuations, i.e., by means of amplitude modulation, so that receiving module 7 receives the pressure signal through these current fluctuations. It is also possible to provide for pulse width modulation instead of amplitude modulation.

Alternatively, it is also possible to provide a bidirectional connection on line 6, i.e. one where the control unit is able to transmit queries to the pressure sensor. Another alternative is a sensor bus. The pressure sensors and also the

control unit may be connected to this sensor bus, as shown in Figure 1. To that end, the connected sensors and the control unit have bus controllers, in order to make data traffic via the bus possible. Such a bus is of benefit in particular where there are a plurality of sensors, in order to reduce cable costs.

Normalization is carried out either by sensor element 1 itself or in signal preprocessor 4, which performs the division of the measured pressure by the ambient pressure, or by processor 8, which ultimately uses the measured value from the pressure sensor to perform the division only in the control unit. These three options are available in principle to be chosen. If normalization is achieved by sensor element 1 itself, then it is possible for example to provide a hole in the pressure sensor diaphragm.

Figure 2 illustrates the sequence of the process which is given by the device. In method step 11 the pressure signal is produced by components 1 through 5 of the pressure sensor, as indicated above. Normalization of the pressure signal may be performed already here by sensor element 1 or by signal preprocessor 4. In method step 12, transmitter module 5 transmits the pressure signal or the normalized pressure signal to the control unit, namely receiving module 7. In method step 13, processor 8 receives the normalized or non-normalized pressure signal, and performs normalization if appropriate. In method step 14, processor 8 uses memory 9 to execute the triggering algorithm, a plausibility signal, preferably from an acceleration sensor, being taken into account. Only if the pressure signal and the plausibility signal indicate an impact does processor 8 recognize an impact in the triggering algorithm, and the system jumps to method step 15 to activate restraining means 10. Parameters such as occupant monitoring and classification are also taken into

account when activating restraining means 10. If no impact was detected in method step 14, then the system jumps back to method step 11.